



YEARWISE AND SEMESTERWISE DISTRIBUTION OF SUBJECTS B.Sc. BIOTECHNOLOGY, CHEMISTRY & GENETICS FIFTH SEMESTER ACADEMIC YEAR-2021-22 OF (2019-22) BATCH (CBCS)									
Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of Exam (hrs)	Marks			Credits
						Internal	External	Total	
THEORY									
1	II	BT21501 A	Toxicology (DSE-1)	3	3	40	60	100	3
		BT21501 B	Stem cell Biology (DSE-1)						
2	II	BT21502 A	Environmental Biotechnology / (DSE-2)	3	3	40	60	100	3
		BT21502 B	food Biotechnology (DSE -2)						
3	II	BT21503	Bioinformatics (Core-14)	3	3	40	60	100	3
4	II	BT21504	Animal Biotechnology (Core-15)	4	3	40	60	100	4
5	II	BT21505	Bioprocess and Fermentation Technology (Core-16)	4	3	40	60	100	4
6	II	BT18506	Chemistry-V (Core-17)	4	3	40	60	100	4
PRACTICALS									
7	II	BT21507	Animal Biotechnology	2	3	40	60	100	1
8	II	BT21508	Bioprocess and Fermentation Technology	2	3	40	60	100	1
9	II	BT18509	Chemistry-V	2	3	40	60	100	1
10	II	BT18510	Summer Project	One month	3	40	60	100	1
11	II	BT21511	Bioinformatics	2	-	40	-	40	1
TOTAL				29		440	600	940	26



Toxicology

Semester: V

Credits: 3

SUBJECT Code: BT21501A

No. of Lecture Hours: 45

Objectives:

To understand how the body's biochemical and physiological mechanisms operate to manage the exposure of toxins, poisons and drugs.

Outcomes:

Identify routes of exposure of environmental toxins and discuss how to educate patients on avoidance.

Unit Specific Outcomes:

- Understand the basics of toxicity and concept of dose-response relationship .
- Understand the concepts of molecular mechanisms of toxicity induction.
- Understand the basics of genetic toxicology.
- Understand the basics of effects of xenobiotics in environmental compartments .
- Understand the effect of toxic substances on health at workplace.

UNIT I –Principles of Toxicology 9 Hrs

- | | |
|--|---|
| 1.1 Definition- toxin, toxicity, scope and importance of toxicology; | 1 |
| 1.2 General concepts of toxicology – hazardous material, ignitability, reactivity, corrosivity and toxicity. | 2 |
| 1.3 Four primary routes of entry – inhalation, ingestion, absorption and injection. | 2 |
| 1.4 Factors influencing toxic action- species and strains, age, sex, nutritional status, hormone, environmental factors. | 2 |
| 1.5 Exposure terminology - Dose, dose effect and dose response relationship –Acute toxicity, chronic toxicity and latent toxicity. | 2 |

UNIT II –Biochemical toxicology 9 Hrs

- | | |
|---|---|
| 2.1 Exposure limits and factors affecting exposure, measurement of toxicity – LD ₅₀ , LC ₆₀ , and TLV. | 2 |
| 2.2 Classification of toxic agents natural toxins- endogenous toxins of plant origin and food contaminants. | 2 |
| 2.3 Free radicals, antioxidants, oxidative stress and redox potential – definitions. | 1 |
| 2.4 Reactive Oxygen and antioxidant in biology and medicine. | 1 |
| 2.5 Origin and formation of ROS and oxygen radicals, Mechanism of tissue damage- protein damage, lipid peroxidation and DNA damage. | 3 |

UNIT III- Genetic toxicology 9 Hrs

- | | |
|---|---|
| 3.1 Biomarkers of protein damage, lipid peroxidation and DNA damage. | 1 |
| 3.2 Antioxidant defense mechanism –classification based on function, location of action, solubility and origin or source. | 2 |



3.3 Genetic toxicity, genotoxic agents, mechanism for genetic damage	2
3.4 Cancer genomics - Proto-oncogenes, tumor suppressor genes, DNA maintenance genes.	2
3.5 Cutaneous toxicities of cancer therapy – alopecia, hand foot syndrome,	2

UNIT IV - Environmental Toxicology **9 Hrs**

4.1 Hazardous wastes – their characteristics.	1
4.2 waste management – Solid, liquids and ewaste.	2
4.3 Eco-toxicology of heavy metals – Mechanism of heavy metal toxicity;	2
4.4 Case studies of Mercury and lead.	2
4.5 Environmental problems by organochlorine and organophosphate pesticides;	2

UNIT V - Occupational Toxicology **9 Hrs**

5.1 Common occupational toxic substances- heavy metals, pesticides, organic substances and gases, vapours and particulates.	2
5.2 Occupational hazards - physical, chemical, biological and mechanical hazards.	2
5.3 Occupational diseases: silicosis, asbestosis;	2
5.4 Prevention of occupational diseases.	1
5.5 Occupational cancer-IARC classes of carcinogens, Primary prevention of occupational cancer	2

Suggested Reading:

- (1) Hodgson, A Textbook of Modern Toxicology, 4 th ed. (J Wiley & Sons: 2010).
- (2) Molecular and Biochemical Toxicology, 4th ed., Smart and Hodgson, eds. (J Wiley & Sons: 2008).
- (3) Frank and Ottoboni, The Dose makes the Poison: A Plain-language Guide to Toxicology, 3 rd ed. eBook, (J Wiley & Sons: 2011).
- (4) Gilbert, A Small Dose of Toxicology: The health effects of common chemicals, (CRC Press: 2004).
- (5) Toxicology and Clinical Pharmacology of Herbal Products, Cupp and Karch, eds. (Springer-Verlag: 2000).



STEM CELL BIOLOGY

Credits: 3

Subject code: BT21501B

Semester: V

No. of lecture Hours: 45

Objective: To offer an opportunity for students to understand the basics of stem cells and genetic engineering of stem cells and their applications.

Outcome: Student will be able to gain knowledge on the types of stem cells and their potential in regenerative medicine.

Unit specific Outcomes:

- Understand the history, characteristics and types of stem cells
- Understand the methods of isolation and culturing of embryonic stem cells
- Understand the types of adult stem cells and differentiation of adult stem cells
- Understand the Genetic Manipulation of stem cells
- Understand Tissue Engineering and Therapeutic Application of Stem Cell

UNIT- I Stem Cell Basics	9Hrs
<ul style="list-style-type: none"> • Historical developments in stem cell biology 3 • Distinguishing features of Progenitor cells and Stem cells 1 • Unique Properties of stem cells –Totipotent, pluripotent, multipotent, unipotent, self-renewal 3 • Types of stem cells – embryonic stem cells - adult stem cells. 1 • Similarities and differences between embryonic and adult stem cells. 1 	
UNIT- II Embryonic Stem Cells	9Hrs
<ul style="list-style-type: none"> • Methods of Isolation of human embryonic stem-Immuno surgery, Mechanical, Enzymatic, Intact blastocyst culture 3 • Blastocyst – inner cell mass – growing ES cells in lab 1 • Laboratory tests to identify ES cells 1 • Stimulation of ES cells for differentiation-spontaneous differentiation, 3 • Properties of ES cells 1 	
UNIT- III Adult Stem Cells	9Hrs
<ul style="list-style-type: none"> • Laboratory Test for identification of adult stem cells 1 • Adult stem cell differentiation-Trans differentiation, de-differentiation, Plasticity 3 • Different types of adult stem cells.-Hematopoietic stem cells, mammary stem cells, intestinal stem cells, mesenchymal stem cells, Neural stem cells 3 • Induced pluripotent stem cell 1 • Properties of Adult stem cells 1 	



UNIT- IV Stem Cell in Drug Discovery	9Hrs
• Manipulating differentiation pathways	3
• Stem cell therapy	1
• Stem cell in cellular assays for screening	1
• Stem cell based drug discovery	2
• Drug screening	2
UNIT- V Genetic Engineering and Therapeutic Application of Stem Cells	9 Hrs
• Transfection methods-microinjection, electroporation, lipofection	2
• Embryonic stem cell Gene Transfer-Injection, co-culture	3
• Therapeutic applications – Parkinson disease	2
• Tissue engineering application	1
• Production of complete organ - kidney	1

SUGGESTED READING:

1. Kursad and Turksen. **Embryonic Stem cells.** 2002. 3rd edition;Humana Press.
2. Jan M. Freshney. **Animal cell culture – A Practical Approach.** 1983. 4th edition; John Wiley Publishers.
3. Primrose, S.B. **Animal Biotechnology.** 1989. Landon. Blackwell Scientific Publication.
4. ED Mather & Barnes. 1998. **Methods in Cell Biology VOL 57 Animal methods.** 1998. Academic Press.
5. ED Butler. **Mammalian Cell Biotechnology- A Practical Approach.** 1991. Oxford UNI Press



ENVIRONMENTAL BIOTECHNOLOGY

Credits: 3

Subject Code: BT21502A

Semester: V

No. of Lecture Hour:45

OBJECTIVES:

To introduce the basic concepts about Environmental Biotech and its importance.

To study the concepts involved in Microbial degradation of pollutants

To explore the possible applications and future potentiality of renewable energy and bioremediation

Outcomes:

Students will develop an advanced understanding of selected topics in Environmental Biotech
The knowledge on Environment will be the key step to proceed towards various concepts in biotechnology.

Unit specific outcomes:

- Understand the concepts of pollution and ecosystem
- Understand the basics of wastewater treatment & bioremediation
- Understand the concepts of biofertilizers & biopesticides
- Understand the basics of renewable, non-renewable resources & biofuel production
- Understand the basics of GMO's & their role in degradation of pollutants.

Unit I: Introduction to Environmental pollution, Ecology and Biodiversity 9hrs

- Environment and its pollution – types of pollution and pollutants, sources of pollution 3
- Concepts of ecosystem, structural aspects of an ecosystem 2
- Functional aspects of an ecosystem 1
- Concept of Biodiversity 1
- Conservation of Biodiversity and its importance 2

Unit II: Bioremediation of Environmental pollution 9hrs

- Microbial treatment of wastewater – sewage and industrial effluents 2
- Solid waste treatment and management – Municipal waste management, 3
- Composting
- Bioremediation – Concepts, *In situ* and *Ex situ* bioremediation 1
- Bioremediation of toxic metal ions – biosorption and bioaccumulation 2



• Concepts of phytoremediation and applications	1
Unit III: Biofertilizers and Biopesticides	9Hrs
• Chemical fertilizers and its impact on environment (eutrophication)	2
• Types of biofertilizers – bacterial, fungal and algal biofertilizers	3
• Pesticides and Insecticides and their impact on environment	2
• Concepts of biopesticides and uses	1
• Types of biopesticides	1
Unit IV: Bioenergy and Biofuels	9Hrs
• Renewable and non-renewable sources of energy	3
• Fossil fuels and their impact on environment	2
• Biomass as a source of energy (bioenergy)	1
• Types of biomass – plant, animal and microbial biomass	2
• Production of bioethanol	1
Unit V: Genetic engineering for pollution abatement	9Hrs
• Genetically modified bacteria for bioremediation of inorganic pollutants	2
• Genetically modified bacteria for bioremediation of organic pollutants – oil spills	2
• Genetically modified bacteria for utilization of lignocelluloses	3
• Environmental risks of Genetically modified organisms	1
• Biosafety of GMO – assessment and management	1
Suggested Readings:	
• Glick Bernard.R, Pasternak Jack.J. Molecular Biotechnology .	
• Das.H.K. 2005. A Text Book of Biotechnology . Wiley Dreamtech India Pvt.Ltd.	
• Jogdand.S.N. 2006. Environmental Biotechnology . Himalaya Publishing House	
• Chatterji.A.K. 2002. Introduction to Environmental Biotechnology . Prentice Hall ofIndia Pvt.Ltd.	
• Singh.B.D. Biotechnology . Kalyani Publishers	



FOOD BIOTECHNOLOGY

Credits : 3
Subject Code: BT21502B

Semester : V
No. of Lecture Hours : 45

Objective: enables students to gain information on role of biotechnology in the field of foods

Outcome: student will acquire knowledge about the biotechnological approaches to improve foods.

Students will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation in field of foods.

Unit specific Outcomes:

- Understand the concepts of food biotechnology
- Understand the Methods of food preservation and principles of canning of food items
- Understand the applications of biotechnology in food processing
- Understand classification and characterization of food industrial wastes and Waste disposal methods
- Understand the importance of Genetically modified food

UNIT I INTRODUCTION

9 Hrs

- Introduction to food biotechnology, History of food biotechnology 1
- Traditional fermented foods - curd, yogurt, cheese, Idli 2
- Modern fermented products - wine, beer, brandy, vinegar 2
- Fermentation of milk, meat, fruits and vegetables 2
- Nutraceuticals 2

UNIT II FOOD PROCESSING

9 Hrs

- Historical evolution of food processing technology. 2
- Causes of food spoilage, Objectives of food processing 2
- Effect of food processing on food constituents (heat, acid and alkali) 2
- Role of microbes in food processing operations 2
- Applications of biotechnology in food processing 1

UNIT III FOOD PRESERVATION AND FOOD ADDITIVES

9Hrs

- Introduction of food preservation, objectives of food preservation 2
- Methods of food preservation- high temperature, osmotic pressure, dehydration 2
- Preservation and principles of canning of food items 2
- Food additives-colour, flavours, emulsifiers and stabilizers 2
- Significance of Food additives 1



UNIT IV WASTE MANAGEMENT OF FOOD INDUSTRIES	9 Hrs
<ul style="list-style-type: none"> • classification and characterization of food industrial wastes from -Fruit and vegetable processing industry, 2 • Beverage industry, 2 • Fish, meat and poultry industry, 2 • Sugar industry and dairy industry, 2 • Waste disposal methods - physical, chemical and biological 1 	
UNIT V GENETICALLY MODIFIED FOOD	9Hrs
<ul style="list-style-type: none"> • Genetically modified food –bovine somatotropin, alpha lactalbumin and lactoferrin in milk 2 • applications of genetically modified food 1 • Food control agencies and their regulations 2 • Safety evaluations of novel food produce 2 • Good manufacturing practices (GMP) 2 	

Suggested Reading:

1. Gautam, N. C., 2007 ,Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree Publishers, New Delhi,
2. Gutierrez – Lopez, G. F. et. al., 2003,Food Science and Food Biotechnology. CRC Publishers, Washington,
3. Maheshwari, D. K. et. al., 2006 ,Biotechnological applications of microorganisms, IK . International, New Delhi,
4. Stanbury, P. F. et. al., 1995, Principles of Fermentation Technology, 2nd Edition, Elsevier, UK.
5. Waites, M. J. et. al., 2007,Industrial Biotechnology: An Introduction, Blackwell publishing, UK.



BIOINFORMATICS

Credits: 3

Subject code : BT21503

Semester: V

No. of lecture hours:45 Hours

Objective:

To equip students with knowledge, skills, competencies and awareness in preparation for careers in bioinformatics.

Outcome:

Students will be able to gain knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics

Unit specific outcomes:

- students will be able to gain knowledge on different types of databases available
- students will acquire basic knowledge on gene prediction methods and scoring matrix significance in alignment of sequences
- students will be able to describe principles and algorithms of pairwise and multiple alignments, and sequence similarity searching
- students will be able to evaluate and analyse methods for secondary structure prediction and phylogenetic tree construction
- students will gain an indepth understanding on modeling of unknown protein structure by using template and application of bioinformatics in various fields

UNIT-1

9Hrs

- Introduction to Bioinformatics, applications and its relation with molecular biology. 1
- General Introduction of Biological Databases (primary, secondary, Composite) 1
- Nucleic acid databases- NCBI, DDBJ , EMBL. 2
- Protein databases (Primary and Secondary) 3
 1. Protein sequence database (Swiss prot Uniprot ,PIR,PROSITE,PRINTS,Blocks)
 2. Protein structure database (PDB,CATH,SCOP)
- Types of formats for databases 2

FASTA/Pearson, GENBANK,PIR/NBRF

UNIT - II

9Hrs

- Basic concept on Genome Analysis 1
- Genome annotation & Gene identification tools(Genscan,,Glimmer) 2
- Gene Prediction–Importance and Methods(Similaritybased search,Ab-intio prediction 3
- Scoring an alignment-Match,Mismatch,Identity,similarity,gaps. 1
- Scoring matrices and their significance-PAM,BLOSUM. 2



UNIT - III	9Hrs
<ul style="list-style-type: none"> • Sequence alignment: • Pair wise alignment methods 3 <ul style="list-style-type: none"> ○ Dot plots. ○ Smith-Waterman(Local Alignment) ○ Needleman-Wunsch (Global Alignment) • Database mining tools <ul style="list-style-type: none"> BLAST 2 FASTA 2 • Multiple sequence alignment(Progressive alignment method, iterative method) 2 	
UNIT-IV	9Hrs
<ul style="list-style-type: none"> • Knowledge based methods for structure prediction: 3 <ul style="list-style-type: none"> ○ Chou fasman method. ○ GOR method. ○ Neural Network method. • Phylogenetic Analysis: 5 <ul style="list-style-type: none"> ○ Distance based method (UPGMA,NJ Method) ○ Character based method (Maximum Parsimony,Maximum likelihood) • Bootstrap analysis 1 	
UNIT – V	9Hrs
Homology Modeling: 3	
Template search, Structurally conserved regions, Sequence alignment, building of loop/Structurally variable regions ,Frame work construction, complete back bone generation,Confirmation search of side chains, Model refinement,	
<ul style="list-style-type: none"> • Threading 2 • Denovo protein structure prediction-Abintio method 2 • Medical applications of Bioinformatics: 2 <ul style="list-style-type: none"> Pharmacogenomics Drug Designing 	

SUGGESTED READING:

1. Rastogi.S.c, Mendiratta Namita, Rastogi parag. 2010. **Bioinformatics**. New Delhi. Himalaya Publishing House.
2. Chikale.N.J, Gomase.V.S. 2007. **Bioinformatics**. New Delhi. Himalaya Publishing House.
3. David W.Mount. 2005. **Bioinformatics-Sequence & Genome Analysis**. New Delhi. SDR Printers.



ANIMAL BIOTECHNOLOGY

Credits: 4

Semester : V

Subject Code: BT21504

No. of Lecture Hours: 60

Objective: To provide students with basic knowledge and applicable skills in animal science

Outcome: Students will be able to gain the knowledge on concepts of animal cell culture

UNIT SPECIFIC OUTCOMES:

- Explain basics concepts of animal cell culture
- Classify the types of animal cell culture media
- Design bioreactors suitable for large scale culture of animal cells
- Apply the principles of genetic engineering to transfect animal cells for industrial use
- Apply the concepts of Transgenic animal

UNIT- I INTRODUCTION

12hrs

- History of development of cell cultures 1
- Laboratory requirements for tissue culture 1
- Substrates (glass, plastic, and metals) 2
- Gas phase for tissue culture 2
- Sterilization techniques 3
- Organ culture-technique, advantages, limitations 3

UNIT- II CULTURE MEDIA

12hrs

- **Natural media:** Clots, Biological fluids, Tissue extracts 1
- **Artificial media:** Serum containing media, 3
Serum free media,
Chemically defined media,
protein free media.
- Growth factors promoting proliferation of animal cells 2
(EGF, FGF, PDGF, NGF, IL – I, IL – II and erythropoietin).
- Growth kinetics of animal cells. 2
- Anchorage dependent cells 2
- NonAnchorage dependent cells. 2



Unit – III	PRIMARY AND SECONDARY CULTURES	12hrs
• Primary culture- sterilization of substrate and medium, Isolation of tissue explants		1
• Disaggregation of explants-Mechanical disaggregation, Enzymatic disaggregation, EDTA treatment, collagenase treatment		3
• Secondary cultures -Cultured cells and evolution of continuous cell lines (established cell lines)		1
• suspension culture -methods, advantages, limitations.		3
• Bioreactors for large- scale culture of cells (Stirred tank, Bubble column, Airlift)		3
• Cell line preservation		1
Unit – IV	EXPRESSION OF FOREIGN GENES IN ANIMAL CELLS	12hrs
• High level expression of foreign genes in animal cells expression vectors, Enhancers		1
• The need to express foreign genes in animal cells: advantage and Disadvantages		1
• Cell culture products--Viral vaccines(Hep B, rabies ,FMDV)		3
• Interferons		1
• Recombinant proteins (Insulin, HGH, tPA)		3
• Monoclonal antibodies		3
Unit– V	TRANSFORMATION TECHNIQUES	12Hrs
• Transfection methods of animal cells- Calcium phosphate, DEAE- dextran, Electroporation, Microinjection		3
• Selection of recombinant cells with various marker genes- Thymidine Kinase, CAD protein, XGPRT		3
• Transgenic animal production of Mice, pig		2
• Transgenic animal production of Fish, sheep		2
• Transgenic animal applications		1
• Ethical issues related to transgenic animals		1

REFERENCE BOOKS:

1. Jan M. Freshney .1983.**Animal cell culture – A Practical Approach**, 4th edition ;John Wiley Publishers.
2. Primrose, S.B.1989. **Animal Biotechnology** ; Blackwell Scientific Publication, London.
3. ED Mather & Barnes .1998. **Methods in Cell Biology VOL 57 Animal methods**; Academic Press.
4. ED Butler.1991. **Mammalian Cell Biotechnology- A Practical Approach**, Oxford UNI Press.



BIOPROCESS AND FERMENTATION TECHNOLOGY

Credits: 4

Subject Code: BT21505

Semester : V

No. of Lecture Hours: 60

Objective:

To provide the basic knowledge of principles of fermentation process, which help students to design, develop and operate industrial level fermentation process.

Outcome:

Students will be able to gain the knowledge on concepts of different fermentation process.

Unit specific outcomes:

- Students will gain knowledge on bioreactor & Apply techniques and processes for batch and continuous sterilization and solve related problems
- students will gain an indepth understanding on different types of fermentor ,sensors and control system for monitoring and controlling bioprocess parameters
- Students will be able to formulate suitable media ,comprehend and apply the inoculum development and strain improvement techniques for a desired fermentation process.
- Students will be able to apply various downstream techniques for product isolation, separation and purification
- Students will be able to learn & Conduct experiments for production, isolation and recovery of bio - products

UNIT- I**Principles of fermentation technology****12Hrs**

- Scope of fermentation technology 1
- Types of fermentations processes – Solid state, surface and submerged fermentations 1
- Microbial kinetics-Batch fermentation, continuous fermentation, Fed batch fermentation 3
- Design of bioreactor-body construction, function of fermentor 3
- Fermentor systems-stirring & mixing ,gas exchange, mass transfer, heat production 1
- Sterilization &types of sterilization-Medium sterilization, , airsterilisation(filters), Sterilization of fermentor, sterilization of liquid waste 3

UNIT-II**Types of fermentors &bioprocess control****12Hrs**

- Types of fermentors-submerged fermenters((stirredtank fermenter , airlift, bubble column, fluidized bed and trickle bed reactor) 5
- Solid state fermenters-tray, static bed,tunnel fermenter. 1
- Instrumentation for controlling bioreactors 2
- Manual &Automatic control system 2
- PID& DSC computer control systems. 2



UNIT- III	12Hrs
Upstream processing	
<ul style="list-style-type: none"> ● Isolation & Screening methods (primary & secondary) 3 ● Preservation methods of industrial important microorganisms. 2 ● improvement of industrial microorganisms –Selection of induced mutants,recombinant systems 2 ● Inoculum development-yeast process,bacterial process,mycelia process 3 ● Media composition & formulation-Carbon source , Nitrogen Source, Oxygen,phosphorus,magnesium,Mineral sources& antifoam agents 2 	
UNIT - IV	12Hrs
Down Stream Processing	
<ul style="list-style-type: none"> ● Filtration 2 ● centrifugation-range of centrifuges 2 ● cell disruption –physical-mechanical,enzymatic, chemical methods 2 ● Liquid-Liquid extractions-two phase ,Supercritical fluid extraction 2 ● Membrane process-Ultrafiltration, reverse osmosis ,Liquid membrane 2 ● Chromatography (Ion exchange , gel permeation, Affinity) ,Drying & crystallization. 2 	
UNIT- V	12Hrs
Fermentation products :	
<ul style="list-style-type: none"> ● Antibiotic production- penicillin production. 2 ● Biofuel production-Ethanol producton. 2 ● Vitamins -Vitamin B-12 production . 2 ● Organic acid-citric acid production. 2 ● Diary products –cheese Production. 2 ● Beverages-Wine Production 2 	

SUGGESTED READING:

1. M.Shuler and F.Kargi.2002. **Bioprocess Engineering Basic Concepts:** Prentice – Hall, India Pvt. Ltd.
2. Stanbury. P.F. 1997. **Principles of Fermentation Technology.** II Edition. New Delhi. Aditya Publications.
- 3.Crueges.W.and Crueges.A. 2003. **Biotechnology-A Text Book of Industrial Microbiology.** New Delhi. Parima Publishing Corporation.
- 4.Casida. L.E. 1968. **Industrial Microbiology.** New Yark. New Age International Publishers.



CHEMISTRY-V

Credits: 4
Subject Code: BT18506

Semester: V
No. of Lecture Hours: 60

Objective:

To understand methods employed for determining speed of reactions & feasibility of given processes, optical activity of product.

Outcome: Students will be able to gain knowledge of organic, physical chemistry in detail and can have a fundamental concept of organic spectroscopy.

Unit Specific Outcomes:

- Analyze various nuclear processes and applications of radio isotopes.
- Explain fundamental concepts of spectroscopic techniques.
- Compare synthesis and properties of nitrogen compounds
- Evaluate photo processes and compare various organometallic compounds
- Evaluate order and molecularity of a reaction and catalytic processes.

UNIT-I	12Hrs
Nuclear Chemistry	
• Definition, Artificial Transmutation with suitable examples.	2
• NUCLEAR FISSION –Definition, explanation. Nuclear Fission as source of energy- Nuclear	
• Reactor & Atom Bomb.	2
• Nuclear reaction Spallation-definition, explanation with an example, Difference from Nuclear	
• fission.	2
• Nuclear Fusion-Definition, explanation, Applications-Energy of Sun & Hydrogen Bomb.	
• Differences between Nuclear fission & fusion.	1
• Applications of Radio Isotopes: -	
• (i) Carbon Dating, Problems.	1
• (ii) Tracers Chemistry.	1
• (iii) Industry & (iv) Agriculture.	1
• (v) Medicine.	1
• (vi) Biochemistry.	1

UNIT-II	12Hrs
Spectroscopy	
UV– VIS Spectroscopy	
• Principle, Instrumentation	2
• Chromophore, Auxochrome, Red shift, Blue shift, hypochromic shift & hyperchromic shift. Solvent Effect. Wood Ward Fieser Rules –Dienes, Polyenes. Applications.	1

**IRSpectroscopy**

- Principle, Sampling Techniques. 2
- Instrumentation, Applications. 1

NMRSpectroscopy

- Principle, Instrumentation. 2
- Chemical Shift, Tentative representation of proton (alkene, alkyne, aromatic, carbonyl), Spin-Spin Coupling, Applications. 2

Mass Spectrometry

- Principle-Types of Peaks, Nitrogen Rule-definition and examples 1
- Definition and examples for -Mc Lafferty Fragmentation, Retro Diels Alder Fragmentation. Applications. 1

UNIT-III**12Hrs****Nitrogen Compounds**

- **Nitro Alkanes**-Preparation methods, physical properties, chemical properties-Halogenation, reaction with HNO₂, reduction, Hydrolysis-NEF Reaction, reaction with aldehydes & ketones, Mannich reaction. 1
- **Aromatic Nitro compound**-Nitro Benzene: Preparation, Physical properties, chemical properties-(i)Nitration (ii)Reaction with (a)KOH(b)NH₃, (iii) Reduction (Sn/HCl, Pt/H₂, LiAlH₄, Zn/NH₄Cl, Zn/NaOH, Selective reduction, Electrolytic Reduction. Conversion of TNT into TNB. 1
- **Cyanides & Isocyanides**-Nomenclature (aliphatic & aromatic), structure, Preparation of Cyanides from (i)Alkyl halides (ii)Amides (iii)Aldoximes. Properties-(i) Weakly basic character (ii)Hydrolysis (iii)Addition of NH₃ (iv)Addition of GR (v)Reduction. 1
- **Isocyanides**-Preparation from (i)Alkyl Halides (ii)Primary amines (iii)isocyanates.Properties-(i)Isomerisation (ii)Hydrolysis (iii)Reduction (iv)Addition of Cl₂, S, HgO. Uses of Cyanides &Isocyanides. 1

Amines & Arene Diazonium Salts

- **Aliphatic Amines**- Nomenclature, Classification into 1⁰, 2⁰, 3⁰ Amines and Quaternary ammonium compounds. Preparation methods- (i)Ammonolysis of alkyl halides (ii)Gabriel Synthesis (iii)Hoffman's bromamide reaction (MECHANISM), (iv)Reduction of Amides (v) Schmidt reaction (vi) from GR 1
- 2⁰ Amines-Preparation-(i) from Cyanides (ii) Ammonolysis of RX. (iii) from GR. 3⁰ Amines-Preparation- (i) from Isocyanides (ii)Ammonolysis of RX, (iii)fromGR 1
- Separation methods of 1⁰, 2⁰, 3⁰ amines by (i) Fractional Distillation (ii) Hoffman Method (iii) Hinsberg Method 1
- Physical Properties, Chemical Properties- (i) Alkylation (ii)Acylation (iii)Carbylamine reaction(MECHANISM), (iv) Reaction with HNO₂ of 1⁰, 2⁰, 3⁰ amines (v) Salt formation (vi)Reaction with CS₂ (vii)Reaction with Aldehydes & Ketones .
- **Aromatic Amines** – Nomenclature, Preparation-(i)Reduction of Nitro Compound 1
- (ii) Ammonolysis of (a)Phenol (b)ArX (iii) Reduction of Azo Compounds. Physical Properties, Chemical Properties- (i) Salt formation (ii)Alkylation (iii) Acylation (iv) Sulphonylation (v)Reaction with HNO₂ (vi)Carbylamine reaction



(vii)Reaction with CS ₂ (viii)Reaction with Aldehydes (ix) ESR- Bromination, Nitration. Aalkyl amines –Examples.	1
• Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline-N-methyl aniline, (N,N-dimethyl aniline(in aqueous and non-aqueous medium), steric effects and substituent effects. Use of amine salts as Phase transfer Catalysts.	1
• Arene Diazonium salts – Diazotization-Preparation, precautions to be taken during preparation (MECHANISM).	1
• Synthetic applications-formation of (i)Phenol (ii)Halo Benzene (iii)Cyano Benzene (iv)Benzene (v)Biphenyl (v)Ether (vi)Phenyl Hydrazene (vii) Nitro Benzene (viii)Azo Dye.	1
UNIT-IV	12Hrs
Photo Chemistry	
• Defintion, photo processes, Lambert’s Law, Lambert Beer’s Law.	1
• Laws of Photo Chemistry-Grothus Drapers Law, Stark-Einstein’s law of Photochemical Equivalence, problems.	2
• Quantum Efficiency-Definition, Calculation, experimental determination of Quantum Yield.	2
• Photo chemical combination of (i)H ₂ + Cl ₂ (ii)H ₂ +Br ₂ , Abnormal quantum yield.	1
Jablonski Diagram-Fluorescence, Phosphorescence, IC,ISC (definitions only), Photosensitized reactions-definition, examples.	1
Organometallic Compounds	
• Definition, Classification-ionic, covalent (sigma bonded, pi bonded), Bridge bonded.	2
• R ₂ Cd, TEL(Anti knocking agent	1
• Grignard Reagent-Preparation, precautions to be taken, Structure, Synthetic Applications-Preparation of (i)alkanes (ii)alkenes (iii)alkynes (iv)alcohols (v) aldehydes (vi) ketones (vii)carboxylic acids (viii) other OMC. Limitations.	2
UNIT – V	12Hrs
Chemical Kinetics & Catalysis	
• Definition, rate of reaction, factors affecting the reaction rate Rate Constant.	1
• Order &Molecularity, differences between order and molecularity.	1
• Zero order reactions, First order reactions- rate constant, characteristics, Half life period and examples, problems.	1
• Second order reactions -Rate Constant-(i) 2A-----→P (ii) A+B-→P (a)when [A]=[B] (b)[A] , [B] are not equal. Examples, Problems.	1
• Pseudo unimolecular reactions-rate constant, examples, Methods of determination of order of reaction.	1
• Effect of temperature on reaction rate-threshold energy, activation energy, Arrhenious equation, problems.	2
• Theories of reaction rates (i) Collision Theory (Elementary Treatment) (ii) Transition state theory	1



Catalysis

- Definition, classification of catalysts-examples, types of catalysis-examples. 1
- Characteristics of catalysis, Enzyme Catalysis, factors affecting enzyme catalysis-Mechanism(M.M.Equation) 2
- Theories of Catalysis-(i)Theory of Homogenous Catalysis, (ii)Theory of Heterogenous Catalysis. 1

ESSENTIAL READING:

O.P. Agarwal. 2014. **Unified course.** (Volume-III & IV). Meerut. Jai Prakash Nath Publications.

SUGGESTED READING:

1. B.S. Bhal, ArunBahl&G.D.Tuli. 2007 **Essentials of physical chemistry.** New Delhi. S.Chand& Company Ltd.
2. Kalsi.P.S. 2006. **Organic Spectroscopy.** U.S. New Age International Publications.
3. Puri,Sharama&Pathania. 2016. **Principles of physical chemistry.** 41st edition. Jalandhar. Vishal Publishing Co.
4. Y.R.Sharma. 2010. **Elementary Organic Spectroscopy.** New Delhi. S.Chand & Co



ANIMAL BIOTECHNOLOGY PRACTICALS

Credits: 1

Semester: V

Subject Code: BT21507

No.of Practical hours: 30

Objective: Students tend to learn concepts, principles of animal cell culture.

Outcome: Students will be able to gain knowledge on preparation of medium and isolation of animal cells.

1. components of animal cell culture media	2
2. Preparation of media	
3. Establishment and maintenance of primary cell cultures.	2
4. Isolation of cells from Chicken Liver	2
5. Isolation of cells from Chick Embryo	2
6. Subculture of monolayer cells	2
7. Subculture of suspension cells.	2

REFERENCE BOOKS:

1. Jan M. Freshney .1983. **Animal cell culture – A Practical Approach**, 4th Edition John Wiley Publishers
2. Primrose, S.B. 1989. **Animal Biotechnology**. Blackwell Scientific Publication, London.
3. ED Mather & Barnes .1998. **Methods in Cell Biology VOL 57 Animal Methods**; Academic Press.
4. ED Butler.1991. **Mammalian Cell Biotechnology- A Practical Approach**; Oxford University Press.



BIO PROCESS AND FERMENTATION TECHNOLOGY PRACTICALS

Credits: 1

Subject Code: BT21508

Semester : V

No of Practical Hours :30

Objective:

Students tend to learn concepts, principles and design of a fermenter.

Outcome:

Students will be able to gain knowledge on medium optimization and production process of industrially important products.

1. Fermenter operations	1
2. Preparation and sterilization of media.	2
3. Isolation and estimation of bacteria from dairy products.	2
4. Bacterial growth curve kinetics.	2
5. Cell disruption	2
6. Batch fermentation and estimation of various microbial metabolites.	
• Citric Acid.	3
• Ethanol.	3

SUGGESTED READING :

1. M.Shuler and F.Kargi.2002. **Bioprocess Engineering Basic Concepts**: Prentice – Hall, India Pvt. Ltd.
2. Stanbury. P.F. 1997. **Principles of Fermentation Technology**. II Edition. New Delhi. Aditya Publications.
3. Crueges.W.and Crueges.A. 2003. **Biotechnology-A Text Book of Industrial Microbiology**. New Delhi. Parima Publishing Corporation.
4. Casida. L.E. 1968. **Industrial Microbiology**. New York. New Age International Publish



CHEMISTRY –V PRACTICALS

Credits :1

Subject Code: BT18509

Objective:

To demonstrate and usage of Instruments like Conductometer, P^H meter, Potentiometer and Polarimeter in Analytical Chemistry.

Semester : V

No. of Practical Hours:30

Outcome: Students will be able to operate various instruments used to estimate amounts of substances in short period of time without using any indicators.

Principles behind Conductometric, P^H metric, Potentiometric titrations. Cause of Optical activity. 3

Demonstration of instruments such as Conductometer, P^H Meter, Potentiometer

Polarimeter. 1

CONDUCTOMETRY : Estimation of amount of given acid-

(1) Strong acid vs Strong base 1

(2) Weak acid vs Strong base 1

P^H METRY : Estimation of amount of given acid –

(1) Strong acid vs Strong base 1

(2) Weak acid vs Strong base 1

POTENTIOMETRY : Estimation of amount of given acid –

(1) Strong acid Vs Strong base 1

(2) Weak acid vs Strong base 1

(3) Precipitation Titration – AgNO₃ vs KCl 1

POLARIMETRY :

(1) Determination of Specific Rotation of Sucrose 2

(2) Determination of Specific Rotation of Glucose 1

Discussion of Viva Questions 1

SUGGESTED READING:

Douglas A. Skoog Douglas A. 2014. **Principles of Instrumental Analysis.** US Brooks Cole.



BIOINFORMATICS PRACTICALS

Credits:1

Course code: BT21511

Semester : V

No. of Practical Hours: 30

Objective:

To apply the data bases and bioinformatics tools for the characterization of DNA, RNA and proteins.

Outcome:

Students will be able to use bioinformatics search tools on the internet for mining data, pairwise and multiple sequence alignments and predict protein structures.

- Getting familiar with databases like NCBI, DDBJ, SWISSPROT, EMBL. 2
- Different formats of structure data: PDB, FASTA, GENBANK. 1
- Get a sequence from database and submit it for pairwise alignment, Retrieve homologous sequence. 2
- Submit the sequence for Blast, FASTA & Analyse. 2
- Submit the sequence for clustal alignment by clustal omega or clustal X. 2
- NJ Plot: Phylogenetic tree construction. 2
- Prediction of secondary structure of proteins online-GOR IV, ChouFasman, Tertiary structure-Swiss Model 2
- Protein and ligand viewer & online viewer : Rasmol, Pymol. 2

SUGGESTED READING:

- Chikale.N.J, Gomase.V.S. 2007. **Bioinformatics**. New Delhi. Himalaya Publishing House.



VI SEMESTER



YEARWISE AND SEMESTERWISE DISTRIBUTION OF SUBJECTS
B.Sc. BIOTECHNOLOGY, GENETICS & CHEMISTRY
SIXTH SEMESTER
ACADEMIC YEAR-2021-22 OF 2019-22 BATCH (CBCS)

S. No.	Part	Subject Code	Title of the Subject	Hours/Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
1	II	BT21601 A	Fundamentals of Genomics & Proteomics DSE-3	4	3	40	60	100	4
		BT21601 B	Enzyme Technology DSE-4						
2	II	BT21602 A	IPR, Bio safety and Bioethics DSE-4	4	3	40	60	100	4
		BT21602 B	Fundamentals of entrepreneurship DSE-4						
PRACTICALS									
3	II	BT21603 A	Fundamentals of Genomics & Proteomics DSE-3	2	3	40	60	100	1
		BT21603 B	Enzyme Technology DSE-4						
5	II	BT18607	Project	20	-	40	60	100	6
TOTAL				30		160	240	400	15



FUNDAMENTALS OF GENOMICS & PROTEOMICS

Credits: 4

Semester: VI

Subject Code: BT21601A

No of Lecture Hours: 60

OBJECTIVES: The course aims to appraise the students to basic and high throughput techniques in Genomics and Proteomics and their applications.

OUTCOMES: On the completion of the course the student will be able to • Infer the basic concepts of genomics, and proteomics. • List and discuss the use of genomics and proteomics in human health. • Suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics fields

UNIT- I

Introduction to Genomics	12 Hrs
➤ Genome definition, Genomics and its diversifications,	4
➤ Structural organization of prokaryotic and eukaryotic genomes;	4
➤ C value paradox,	
➤ Types and significance of repeats in the genome,	4

UNIT- II

Sequencing techniques	12 Hrs
➤ DNA Sequencing Methods- Manual & Automated	4
➤ First generation : Maxam & Gilbert, Sangers Method	4
➤ Second generation - NGS	1
➤ Third generation – Nanopore	2
➤ PyroSequencing,	1

UNIT- III

	12 Hrs
➤ Computer tools for sequencing projects	3
➤ Genome sequence assembly software	3
➤ Managing and Distributing Genome Data	3
➤ Web based servers and software's for genome analysis	3

UNIT- IV

Introduction to Proteomics	12 Hrs
➤ Introduction to protein structure – Primary, Secondary and Tertiary	1
➤ Chemical properties of amino acids	2
➤ Physical interactions that determine the property of proteins	4
➤ Electrostatic forces, van der waal interactions	3
➤ Hydrogen bonds, Hydrophobic interactions.	2

UNIT- V

	12 Hrs
Proteomic technologies	
➤ Determination of sizes (Sedimentation analysis, gel filtration,)	4
➤ Analysis of proteomes, 2D-PAGE.	3
➤ Mass spectrometry based methods for protein identification (Lc-ms, ms)	3
➤ Application of Mass spectrometry	2



SUGGESTED READING

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing. 1987.
3. Molecular Biotechnology, Principles and Applications of Recombinant DNS, 4th Edition
B.R. Glick, J.J. Pasternak and C.I. Pattern ,2010
4. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989
5. Principles of Gene Manipulation 6th Edition, S.B. Primrose, R.M. Twyman and R.W. Old.

Blackwell Science, 2001



ENZYME TECHNOLOGY

Credits : 04
Subject code : BT21601B

Semester: VI
No. of Lecture Hours:60

OBJECTIVES

- To introduce the basic concepts about enzymes and its production.
- To study the techniques used in Enzyme technology.
- To explore the possible applications and future potentiality of Enzyme technology.
- To describe advanced information about immobilized enzyme systems and biosensors.

OUTCOMES:

- The knowledge on enzyme and enzyme reactions will be the key step to proceed towards various concepts in biotechnology.
- Ideas on processing ,production and purification of enzymes will be helpful to work technologically

Unit Specific Outcomes:

- Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms
- Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.
- Compare methods for production, purification, characterization and immobilization of enzymes
- Discuss various application of enzymes that can benefit human life
- Understanding the role of enzymes used in Molecular biology and application of biosensors.

UNIT I

Introduction to Enzyme technology	12 Hrs
• Introduction to Enzyme Technology – Definition, Historical developments.	2
• Scope and importance of Enzyme Technology	1
• Nature of enzymes	1
• Mechanism of Enzyme Action	2
• Energetics of enzyme substrate complex formation;	2
• Types of inhibition – Competitive, un competitive inhibition, feed back inhibition.	2
• Allosteric Enzymes and its regulation –Concerted model and Sequential model.	2

UNIT II

Application of enzymes	12 Hrs
• Commercial application of enzymes - thermophilic enzymes, amylases,	2
• lipases, and Proteases.	2
• Enzymes used in various fermentation processes	2
• Cellulose degrading enzymes	1
• Artificial enzymes- its applications	1
• Production and Purification of Crude Enzyme extracts from Plant, animal and microbial sources.	4

**UNIT III****Enzyme Immobilisation****12 Hrs**

- Definition, characteristics of immobilization 3
- Methods of Enzyme immobilization -Physical and Chemical techniques for enzyme immobilisation – adsorption, encapsulation, cross linking and covalent binding. 3
- Advantages and disadvantages of different immobilization techniques 3
- Overview of application of immobilized enzyme systems. 3

UNIT IV**Enzymes for Clinical diagnosis****12 Hrs**

- Determination of enzyme activity for clinical diagnosis of Liver disease 3
- Determination of enzyme activity for clinical diagnosis of Heart disease 2
- Detection and significance of enzyme deficiencies (Phenylketonuria & Galactosaemia) 3
- Enzymes in determination of metabolites of clinical importance (Blood glucose, Uric acid & Cholesterol) 4

UNIT V**Industrial and therapeutic enzymes and Enzyme Biosensors****12 Hrs**

- Functions of enzymes used in genetic engineering- restriction endonuclease, methylases, Ligases, DNA Polymerases, DNA nucleases. 4
- Enzyme replacement therapy – definition, modes of administration. 2
- Enzyme therapy for digestive disorders and cancer. 3
- Enzyme based Biosensors- history, components, working principle and applications of biosensors. 3

SUGGESTED READINGS**Textbook:**

1. Chaplin M.,and Bucke C. (1990) Enzyme Technology, Cambridge University Press.

References :

1. Garrett R. and Grisham C. M., 2010, Biochemistry, 4th Ed, Brooks/Cole.
2. Aehle W., 2008, Enzymes in industry - production and applications, Wiley-VCH.
3. Glick B. R., Pasternak J. J., Patten C. L.2007. Molecular Biotechnology, principles and applications of recombinant DNA, 4th ed, ASM Press, Washington DC.
4. Price N. C.and Stevens L., 2004. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, Oxford University Press



IPR, BIOETHICS&BIOSAFETY

Credits:4

Subject Code :BT21602A

Semester : VI

No. of Lecture hours: 60

Objective:

To impart knowledge on the fundamentals of Biosafety , Bioethics, Intellectual Property Rights, Research Methodology and Entrepreneurship.

Outcome: student will acquire knowledge about the Biosafety, Necessity of Bioethics ,Research Methodology, Nature and importance of Entrepreneurs

Unit specific Outcomes:

- Understand Biosafety for human health and environment
- Understand Necessity of Bioethics and Causes of unethical acts.
- Understand Intellectual property rights and plant breeders rights
- Understand different aspects involved in carrying out research.
- Understand Entrepreneurship, Nature and importance of Entrepreneurs

UNIT-I Biosafety

12Hrs

- | | | |
|--|---|---|
| • Definition and Introduction to biosafety | 1 | |
| • Biosafety for human health and environment. | | 2 |
| • Different containment levels of Biosafety | | 3 |
| • Use of GMO – BT Cotton its release into the environment. | | 3 |
| • BT brinjal its release into the environment | | 2 |
| • Hazardous chemicals | | 1 |

UNIT-II Bioethics

12 Hrs

- | | | |
|--------------------------------|--|---|
| • Introduction to Bioethics | | 1 |
| • Necessity of Bioethics | | 1 |
| • Causes of unethical acts. | | 2 |
| • Ethical decision making | | 2 |
| • Good laboratory practices. | | 3 |
| • Good Manufacturing Practices | | 3 |

UNIT-III Intellectual Property Rights

12Hrs

- | | | |
|--|--|---|
| • Introduction and history of Intellectual property rights. | | 1 |
| • Types of Intellectual Property Rights :Patent,trademarks,copy right trade secret | | 3 |
| • Patent-objectives,rights,infringement | | 3 |
| • International organizations-world trade organization (WTO),Trade-Related Aspects of Intellectual property rights (TRIPS) | | 2 |
| • Plant breeders' Protection. | | 3 |



UNIT-IV	Research Methodology	12Hrs
•	Literature search – information sources,	1
•	library resources- books, journals, abstracts.	3
•	online literature search – internet access, websites,	2
•	Design of the experimental programme	3
•	Plagiarism,	1
•	Preparation and publication of research papers.	2
UNIT-V	Entrepreneurship	12Hrs
•	Introduction and theories of Entrepreneurship	3
•	Nature and importance of Entrepreneurs	2
•	Marketing channels – methods of marketing,	3
•	Project Report –Preparation, contents, significance	3
•	proforma of a project report.	1

SUGGESTED READING:

1. Raj Mohan Joshi. 2006. Biosafety and Bioethics. New Delhi. Isha Books.
2. Rao.M.B& Manjula Guru. 2007. Biotechnology,IPR and Biodiversity. New Delhi. Saurabh Printers Pvt Ltd.
3. Yogesh kumarsingh&Ruchikanath. 2007. Research Methodology. New Delhi. APH publishing corporation.



FUNDAMENTALS OF ENTERPRENEURSHIP

Credits: 4

Subject Code: BT 21602B

Semester : VI

No. of Lecture Hours: 60

Objective:

To impart knowledge on the fundamentals of Entrepreneurship .To understand basic concepts in the area of entrepreneurship

To understand the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

Outcome:

Students will be able to analyse the business environment in order to identify business opportunities and consider the legal and financial conditions for starting a business venture

Students will be able to interpret their own business plan.

Unit specific outcomes:

- students will be able to gain basic knowledge on Entrepreneurship,its characteristics features and importance.
- students will acquire knowledge on setting up a startup,developing Entrepreneurial plan & project selection.
- students will gain an in depth understanding on project classification,report & marketing methods
- students will be able to gain knowledge on importance of finance in business,loans & repayments.
- students will be able to gain basic knowledge on International business, export of products

UNIT I- INTRODUCTION

12 hrs

- Meaning, Needs and Importance of Entrepreneur& Entrepreneurship 2
- Characteristics and functions of entrepreneur 2
- Classification of entrepreneurs (2)
- Promotion of entrepreneurship .(2)
- Factors influencing entrepreneurship (2)
- Features of a successful Entrepreneurship. (2)

UNIT II- ESTABLISHING AN ENTERPRISE

(12 hrs)

- Developing Entrepreneurial plan (3)
- Forms of Business Organization . (2)
- Startup and different types of startups (2)
- Project Identification.,Selection of the product. (3)
- Assessment of project feasibility. . (2)



UNIT III MARKETING AND SET UP OF INDUSTRY

(12hrs)

- Marketing channels – methods of marketing. (3)
- Setting up a small scale industry – location of an enterprise, steps for starting a small industry. . (3)
- Project classification–meaning & different phases of project-identification, formulation, appraisal, selection implementation . (3)
- Project Report –Preparation, contents, significance & proforma of a project report. (3)

UNIT IV- FINANCING THE ENTERPRISE

(12hrs)

- Importance of finance . (3)
- loans and repayments. (3)
- Characteristics of Business finance. (3)
- Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management. .(3)

UNIT V -ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS

(12hrs)

- Challenges in Entrepreneurship:Business succession and continuing from family business perspective,sccesion policy,problems of innovation and change . (2)
- Meaning of International business . (2)
- Selection of a product. (2)
- Selection of a market for international business. (2)
- Export financing Institutional support for exports. . (2)
- Project Report on a selected product should be prepared and submitted. . (2)

SUGGESTED READING:

1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM Patterns of Entrepreneurship.
3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management



FUNDAMENTALS OF GENOMICS & PROTEOMICS PRACTICALS

Credits: 1

Subject Code: BT21603A

Semester: VI

No of practical Hours: 30

OBJECTIVES: The course aims to appraise the students to basic and high throughput techniques in Genomics and Proteomics and their applications.

OUTCOMES: On the completion of the course the student will be able to • Infer the basic concepts of genomics, and proteomics. • List and discuss the use of genomics and proteomics in human health. • Suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics fields.

1. Use of SNP databases at NCBI and other sites	2
2. Use of OMIM Database	2
3. Detection of Open Reading Frames using ORF Finder	2
4. SDS-PAGE	2
5. Proteomics 2D PAGE Database	3
6. Native PAGE	2
7. Chromatography-Column Chromatography	2

SUGGESTED READING

6. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
7. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing. 1987.
8. Molecular Biotechnology, Principles and Applications of Recombinant DNS, 4th Edition
B.R. Glick, J.J. Pasternak and C.I. Pattern ,2010
9. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989
10. Principles of Gene Manipulation 6th Edition, S.B. Primrose, R.M. Twyman and R.W. Old.
Blackwell Science, 2001.



ENZYME TECHNOLOGY PRACTICALS

Credits:1
Subject Code :BT21603B

Semester: VI
No. of Lecture Hours: 30

Objectives

To study the techniques used in extraction of enzymes and assay of enzymes.

Outcomes:

Student can analyse the concentrations, physical characteristics of enzymes.

- | | |
|---|---|
| 1. Isolation and production of amylase. | 3 |
| 2. Assay of amylase. | 2 |
| 3. Isolation and purification of lysozyme from egg white. | 2 |
| 4. Screening of microbes for amylase production on starch agar plates | 2 |
| 5. Characterization of enzyme-Effect of pH on enzyme activity. | 2 |
| 6. Characterization of enzyme-Effect of temperature on enzyme activity. | 2 |
| 7. Immobilization of enzyme by Sodium alginate method. | 2 |

Laboratory manuals

Laboratory Manual Reference book R. Eienthal and M.J. Dansen, "Enzyme Assays –A Practical Approach", IRL Press, Oxford University Press, Ox



PROJECT EVALUATION CRITERIA

Credits : 6

Subject Code : BT18607

Semester : VI

No. of Project Hours:20 Hrs/ Week

Third year students in the Second Semester are required to take up a project work which carries a total of 100 marks i.e. internal 40 marks and external 60 marks.

The Criteria for the Internal Evaluation of Project for 40 marks as follows:

Attendance - 5 marks

Review of literature - 5 marks

Internal project presentations /Practical - 10 marks

(Presentation & communication skills, objectives, work submission, methodology, results, practical relevance.)

Final internal presentation - 15 marks

(50% marks Evaluation done by the internal guide, & 50% marks evaluated by other internal lecturers guiding the projects).

Project Report -5 marks

External Evaluation of the Project (60 marks): The Controller of Examination sends the Project Reports to the External Examiner in advance. The External Examiner evaluates the project for 60 marks. Project Report is evaluated for 40 marks and Viva for 20 marks.